MATHEMATICS (MATH)

MATH 5301 Foundations for Advanced Mathematics
3 Semester Credit Hours (3 Lecture Hours)
This course is an advanced treatment of the foundations of calculus, linear algebra and differential equations. Major focus on the proofs of theorems in the ares of analysis, linear algebra and differential equations. Topics are as follows: • Analysis: properties of the real numbers, sequences and series, limits, convergence, continuity, the derivative, and the Riemann integral. • Linear Algebra: matrix theory, system of equations, vector spaces, eigenvalues and eigenvectors, diagonalization and orthogonalization, change of basis. • Differential Equations: ordinary differential equations, solutions in series, solutions using Laplace transforms, systems of dfferential equations, applications.
Prerequisite: MATH 2415.

MATH 5310 Topics in Mathematics
3 Semester Credit Hours (3 Lecture Hours)
May not be used for graduate credit towards the MS in mathematics. Course included to provide a suitable vehicle for anticipated future service courses.

MATH 5311 Statistical Learning
3 Semester Credit Hours (3 Lecture Hours)
This course will introduce students the problem of supervised (classification and regression) and unsupervised learning (dimension reduction and clustering) from the perspective of statistical learning. It aims to go far beyond the classical statistical methods. Students will learn a collection of flexible tools and techniques for using data to construct prediction algorithms and perform data analysis. Topics will include splines & generalized additive models, model selection & regularization methods (ridge and lasso), tree-based methods, random forests & boosting as well as classical linear approaches such as Logistic Regression, Linear Discriminant Analysis, K-Means, Clustering and Nearest Neighbors. Programming in R will be used to provide hands-on training and examples.

MATH 5315 Statistical Methods in Research I
3 Semester Credit Hours (2 Lecture Hours, 2 Lab Hours)
STATISTICAL METHODS IN RESEARCH I This course is for graduate students in other disciplines and is designed to prepare them to use statistical methods in their research. This is a non-calculus exposition of the concepts, methods and usage of statistical data collection and analysis. Topics include descriptive statistics, the t-test, the one and two-way analysis of variance, multiple comparison tests, and multiple regression. Students also learn how to conduct these analyses using computer software and how to properly report their findings.

MATH 5316 Statistical Methods in Research II
3 Semester Credit Hours (2 Lecture Hours, 2 Lab Hours)
STATISTICAL METHODS IN RESEARCH II This course is a continuation of MATH 5315. Topics include: statistical experimental design, randomized blocks and factorial analysis, multiple regression, chi-squared tests, analysis of covariance, non-parametric methods and sample surveys. Emphasis will be placed on the computer analysis of research data and how to properly report statistical findings.
Prerequisite: MATH 5315.

MATH 5321 Problem Solving and Mathematical Reasoning for Teachers
3 Semester Credit Hours (3 Lecture Hours)
An investigation of problems that span a variety of domains with a focus on making and evaluating mathematical arguments, using tools such as manipulatives and technology, identifying and analyzing the connections within and outside of mathematics-, and using symbols and representations to communicate mathematical ideas.

MATH 5322 Mathematics Assessment
3 Semester Credit Hours (3 Lecture Hours)
A historical overview of assessment of mathematics, statistical description of norm- and criterion-reference tests, scaling of standardized exams, varieties of assessment and rubrics, the mathematical analysis of error patterns, and equity.

MATH 5323 Mathematics instruction and Mentoring
3 Semester Credit Hours (3 Lecture Hours)
A study of how the use of appropriate mathematical content can create and support a mathematics classroom environment in which students are engaged in mathematical problem solving and how to use these understandings to be effective in supporting teacher development.

MATH 5324 Principles of Reforming Mathematics Instruction
3 Semester Credit Hours (3 Lecture Hours)
This course introduces participants to the theory and practice of teacher-led inquiry within mathematics education. The course prepares teachers to engage in a school-based mathematics education action research project. It is intended for in-service mathematics teachers.

MATH 5325 Structure of Number Concepts
3 Semester Credit Hours (3 Lecture Hours)
An in-depth investigation of real and complex number systems, base ten and other number bases, operations and algorithms, divisibility, Euclidean algorithm, congruence, modular arithmetic, and the Fundamental Theorem of Arithmetic, with an emphasis on quantitative and qualitative reasoning.

MATH 5326 Structure of Patterns and Algebra
3 Semester Credit Hours (3 Lecture Hours)
Algebraic reasoning incorporating the use of technology. This course includes investigations of patterns, relations, functions, and analysis, with a focus on representations and the relationships among them.

MATH 5327 Structure of Geometry and Measurement
3 Semester Credit Hours (3 Lecture Hours)
An investigation of concepts and principles in geometry and measurement with emphases on deductive reasoning and on inductive reasoning with the use of dynamic geometry software.

MATH 5328 Structure of Probability and Statistics
3 Semester Credit Hours (3 Lecture Hours)
An investigation of the principles and applications of probability and descriptive and inferential statistics.

MATH 5329 Structure of Modeling with Rates of Change
3 Semester Credit Hours (3 Lecture Hours)
A study of rates of change through modeling. Direct applications of rates of change to number concepts, algebra, geometry, probability, and statistics.

MATH 5331 Evolution of Mathematical Systems
3 Semester Credit Hours (3 Lecture Hours)
Covers the evolution of mathematical concepts and thought from ancient to modern times, including women and men who played key roles, from original and secondary sources. Provides a better understanding of the historical development of larger context for topics studied in other courses, and deepens understanding and appreciation of these topics. This course is intended to benefit current and future mathematics teachers.
Prerequisite: MATH 5321.

MATH 5332 Integrating Technology in Mathematics Education
3 Semester Credit Hours (3 Lecture Hours)
An introduction to technology appropriate for the mathematics classroom, including calculators, CAS systems, handhelds, computer software and multimedia. This course is intended for in-service mathematics teachers at the middle/high school level.
Prerequisite: MATH 5321.

MATH 5333 Numerical Linear Algebra
3 Semester Credit Hours (3 Lecture Hours)
Direct methods for linear systems. Least square solutions. Symmetric and nonsymmetric eigenvalue problems. Iterative methods. Algorithms.
Prerequisite: MATH 3311.

MATH 5336 Advanced Differential Equations
3 Semester Credit Hours (3 Lecture Hours)
A continuation of MATH 3315, Differential Equations. Relying heavily on linear algebra concepts, this course covers linear systems of differential equations; introductory operator theory; existence, uniqueness and continuity of solutions; stability of equilibria; planar nonlinear systems; and the Poincaré-Bendixson Theorem. Several applications are covered to illustrate the mathematical concepts.
Prerequisite: MATH 3311 and 3315.

MATH 5337 Theory and Applications of Partial Differential Equations
3 Semester Credit Hours (3 Lecture Hours)
The purpose of this course is to study the mathematical theory and real-world applications of the three major categories of partial differential equations: elliptic equations, parabolic equations, and hyperbolic equations. Specific topics to be covered include: first-order equations, second-order elliptic equations, second-order parabolic equations, and second-order hyperbolic equations.
Prerequisite: MATH 3311, 3315, 4301 and 4315.

MATH 5338 Finite Elements Method
3 Semester Credit Hours (3 Lecture Hours)
This is a one-semester course on finite element method for the numerical solution of partial differential equations. The course will focus on basic concepts of the finite element method for elliptic boundary value problems. Topics include: the weak (variational) formulation of prototypical problems, coercivity and continuity arguments, inf-sup conditions, approximation theory of finite elements, error analysis, stability, and a discussion of variational "crimes".

MATH 5339 Numerical Analysis
3 Semester Credit Hours (3 Lecture Hours)
Error estimation. Solution of non-linear equations. Interpolation. Numerical differentiation and integration. Finite differences and finite elements. Numerical methods for ODE's and PDE's.
Prerequisite: MATH 3311, 3315, 3470 and 4315 and (COSC 5311 or 1435).

MATH 5340 Numerical Solutions of Partial Differential Equations
3 Semester Credit Hours (3 Lecture Hours)
The course introduces numerical methods, especially the finite difference method for solving partial differential equations. The main numerical issues such as convergence and stability will be discussed. It also includes an introduction to the finite volume method, finite element method and spectral method. The course is enhanced by the computational and graphical capabilities of PYTHON.

MATH 5341 Statistical Methods and Data Analysis
3 Semester Credit Hours (3 Lecture Hours)
Introduction to the basic concepts of probability, common distributions, statistical methods, data analysis and a wide variety of statistical inference techniques. Demonstrations of the interplay between probability models and statistical inference. Data sets will be analyzed using the R software package.
Prerequisite: (MATH 3342 or 3345).

MATH 5342 Linear Statistical Models
3 Semester Credit Hours (3 Lecture Hours)
Review of basic concepts in probability theory. Principles of estimation and model building. Linear models, especially ANOVA and regression. Non-parametric alternatives.
Prerequisite: MATH 3311, 3342 and 3470.

MATH 5343 Mathematical Theory of Statistics
3 Semester Credit Hours (3 Lecture Hours)
This course is intended for graduate students that need a solid background on statistical theory. This is a one-semester course in probability and mathematical statistics. Topics include: basic probability, random variables, transformations and expectations, distributions and important families thereof, multiple random variables, random samples, notions of convergence, and an overview of point estimates and hypothesis tests.
Prerequisite: MATH 3311, 2415 and 3342.

MATH 5344 Environmental Statistics
3 Semester Credit Hours (3 Lecture Hours)
SPATIAL STATISTICS An introduction to methods of spatial statistics commonly used in scientific settings. Topics include the nature of geospatial sampling, analysis and modeling of spatial point patterns, and development and analysis of common continuous spatial models such as kriging. Additional topics to be covered, as time and student interest permit, include Bayesian modeling, hierarchical environmental modeling, and spatiotemporal modeling. Use of appropriate software is emphasized.
Prerequisite: MATH 3342 or 5315.

MATH 5345 Computational Methods for Statistics
3 Semester Credit Hours (3 Lecture Hours)
An introduction to computing tools needed by the modern statistician. Topics include: floating point numbers, reformatting large datasets, important statistical algorithms, and parallel processing.

MATH 5348 Optimization
3 Semester Credit Hours (3 Lecture Hours)
Unconstrained optimization, necessary and sufficient conditions for solutions, basic algorithms. Constrained optimization, KKT conditions, linear programming, convex programming, algorithms.
Prerequisite: MATH 4301.

MATH 5351 Real Analysis
3 Semester Credit Hours (3 Lecture Hours)
This course includes such topics as sequences and series of constants and functions, the Riemann integral, Fourier Series, and an introduction to Lebesgue measure and integration.
Prerequisite: MATH 4301.

MATH 5360 Combinatorics and Graph Theory
3 Semester Credit Hours (3 Lecture Hours)
Topics to include basic counting rules, connectivity, graph coloring and applications, chromatic polynomials, trees and their applications to searching and sorting, generating functions, recurrence relations, the Pigeonhole Principle, Eulerian and Hamiltonian chains and paths, and applications.
Prerequisite: MATH 2305 and 3313.

MATH 5370 Modeling of Natural Systems
3 Semester Credit Hours (3 Lecture Hours)
This course is designed to expose science and technology majors to models of real problems arising in the environment and ecology. Students will learn how to create solvable models of the real world situations and how to find answers on the posted questions by using tools of mathematics and computing. There will be modeling and simulations of tides in the Gulf of Mexico, multi-species models of the food chains, circulation of carbon, water, and oxygen. Students will learn some new tools based on calculus and elementary statistics such as numerical algorithms, Monte-Carlo methods, Markov Processes, multivariate analysis, evaluation of stability, methods of extrapolation (predictions) and interpolations.
Prerequisite: (MATH 1442 or 2342) and (MATH 2413 or 5329).

MATH 5375 Applied Analysis
3 Semester Credit Hours (3 Lecture Hours)
Topics to include basic theory of Euclidean, Banach and Hilbert spaces, calculus of variations and optimal control, elements of system analysis, and elements of complex analysis. All theoretical topics will be illustrated by real application.
Prerequisite: MATH 4301 or 5351.

MATH 5378 Mathematical Modeling
3 Semester Credit Hours (3 Lecture Hours)
Modeling of applied problems using analytical, stochastic, and dynamical methods.

MATH 5390 Special Topics
1-3 Semester Credit Hours (1-3 Lecture Hours)
An advanced study of a mathematical topic. May be repeated with full credit in another area of mathematics. Topics vary by semester and offering.

MATH 5393 Literature Review and Research
3 Semester Credit Hours (3 Lecture Hours)
LITERATURE REVIEW AND RESEARCH METHODOLOGY Reading, analyzing, and synthesizing mathematics education research literature for the purpose of informing teaching practice. Includes a study of qualitative research with a focus on the components of a research study (research question(s), literature review, conceptual framework, methods, analysis, findings) and the relationships among them.

MATH 5394 Research Methods in Mathematics
1-3 Semester Credit Hours
RESEARCH METHODS IN MATHEMATICS This course develops an ability to independently investigate a technical topic of interest, and the skills necessary to successfully communicate on that topic. The student learns how to find, organize, assimilate, and report on technical information derived from published sources. Specific areas of study include literature searches, technical word processing, technical writing style, and oral presentation techniques. The instructor and selected additional faculty members review and critique oral and written reports submitted throughout the semester. A final paper and a formal presentation are submitted in lieu of a final exam in the final semester. This course is a co-requisite for all other courses (except thesis) taken by students in the Environmental Modeling option.

MATH 5396 Directed independent Study
3 Semester Credit Hours
Study in areas of current interest. See College description for further details.

MATH 5993 Literature Review and Research
1-9 Semester Credit Hours
Reading, analyzing, and synthesizing appropriate mathematics and/or mathematics education research literature under supervision. May be repeated for credit.

MATH 5994 Proposal Research
1-9 Semester Credit Hours
This course develops an ability to independently investigate a technical topic of interest, and the skills necessary to successfully communicate on that topic. The student learns how to find, organize, assimilate, and report on technical information derived from published sources. Specific areas of study include literature searches, technical word processing, technical writing style, and oral presentation techniques. A final paper and a formal presentation are submitted in lieu of a final exam in the final semester.

MATH 5995 Thesis
1-9 Semester Credit Hours
Students work with an advisor to complete and present their proposed thesis. Students may register for 3 to 9 semester hours per semester. Only 3 hours total will count toward the MS degree in mathematics.
Prerequisite: MATH 5994.

MATH 5997 Project
1-9 Semester Credit Hours
Students work with an advisor to complete and present their proposed research project. Students may register for 3 to 9 semester hours of directed research per semester. Only 3 hours total will count toward the MS degree in mathematics.
Prerequisite: MATH 5994.

MATH 6315 Statistical Methods in Research I
3 Semester Credit Hours (2 Lecture Hours, 2 Lab Hours)
This course is for graduate students in other disciplines and is designed to prepare them to use statistical methods in their research. This is a non-calculus exposition of the concepts, methods and usage of statistical data collection and analysis. Topics include descriptive statistics, the t-test, the one and two-way analysis of variance, multiple comparison tests, and multiple regression. Students also learn how to conduct these analyses using computer software and how to properly report their findings.

MATH 6316 Statistical Methods Research II
3 Semester Credit Hours (2 Lecture Hours, 2 Lab Hours)
This course is a continuation of MATH 6315 . Topics include: statistical experimental design, randomized blocks and factorial analysis, multiple regression, chi-squared tests, analysis of covariance, non-parametric methods and sample surveys. Emphasis will be placed on the computer analysis of research data and how to properly report statistical findings.
Prerequisite: MATH 6315.

MATH 6317 Mixed Effects Models for Scientists
3 Semester Credit Hours (3 Lecture Hours)
This course will deal with extensions to the regression and ANOVA that are frequently useful in dealing with ecological data. Topics include: using bootstrapping for significance testing; generalized additive models; using generalized least squares to deal with non-homogeneous data; working with fixed and random factors; handling temporally correlated and spatially correlated data; and the generalized linear model (Poisson, logistic, and negative binomial regression).
Prerequisite: MATH 6315 or 6316.

MATH 6318 An Introduction to Bayesian Statistics
3 Semester Credit Hours (3 Lecture Hours)
An introduction to Bayesian Statistics for scientists. Topics include: Bayesian paradigm, with advantages and disadvantages; brief coverage of probability and calculus; basics of Markov Chain Monte Carlo methods, including the Gibbs sampler and the Metropolis-Hastings algorithm; validating, comparing, and interpreting Bayesian models; and examples from literature relevant to students interests. The course assumes no prior exposure to calculus or programming.

MATH 6344 Spatial Statistics
3 Semester Credit Hours (3 Lecture Hours)
An introduction to methods of spatial statistics commonly used in scientific settings. Topics include the nature of geospatial sampling, analysis and modeling of spatial point patterns, and development and analysis of common continuous spatial models such as kriging. Additional topics to be covered, as time and student interest permit, include Bayesian modeling, hierarchical environmental modeling, and spatiotemporal modeling. Use of appropriate software is emphasized.
Prerequisite: MATH 3342 or 5315.